MARKED-UP VERSION OF THE AMENDED CLAIMS

(Version with Marking to Show Changes Made)

1. (three times amended) A built-up camshaft comprising

a pipe coated by a jointing coating on an outer cylindrical surface and an inner cylindrical surface and having an outer pipe diameter and an inner pipe diameter and having cam places, bearing ring places and pipe end places;

cams formed as rings with an outer cylindrical flange and an inner cylindrical flange and provided with the jointing coating on an inner cylindrical surface of the inner cylindrical flange [and having a cam opening diameter slightly smaller than the outer pipe diameter] and positioned at the cam places and bearing rings provided with the jointing coating on inner surfaces being in contact with the pipe and [having an inner ring diameter slightly smaller than the outer pipe diameter and] positioned at the bearing ring places and end pieces provided with the jointing coating on outer cylindrical surfaces and having an outer end pieces diameter bigger than the inner pipe diameter, wherein the jointing

coating of the pipe and the jointing coating of the cams, the bearing rings and the end pieces create durable joints between the pipe and the cams, the bearing rings and the end pieces and wherein the surface coating prevents a tribocorrosion and increases load capacity as compared to []conventional compression joints.

6. (amended) A built-up camshaft comprising

a pipe coated with a crystalline phosphate coating on an outer cylindrical surface and on an inner cylindrical surface and having an outer pipe diameter and an inner pipe diameter;

cams and bearing rings [having an inner diameter smaller than the outer pipe diameter] and end pieces having an outer diameter bigger than the inner pipe diameter and connected by means of compression joints to the pipe and provided with the crystalline phosphate coating on surfaces being in contact with the pipe, wherein the crystalline phosphate coating prevents a tribocorrosion and increases load capacity as compared to [conventional] compression joints and creates stable joints between the pipe and the cams, the bearing rings and the end pieces.

7. (amended) A built-up camshaft comprising

a pipe coated by a cement on an outer cylindrical surface and an inner cylindrical surface and having an outer pipe diameter and an inner pipe diameter;

cams and bearing rings [having an inner diameter smaller than the outer pipe diameter] and end pieces having an outer diameter bigger than the inner pipe diameter and connected by means of compression joints to the pipe and provided with the cement on surfaces being in contact with the pipe, wherein the cement prevents a tribocorrosion and increases load capacity as compared to [conventional] compression joints.

9. (new) A built-up camshaft comprising

a pipe coated with a crystalline phosphate coating on an outer cylindrical surface and having an outer pipe diameter;

a cam having an inner diameter larger than the outer pipe diameter and connected by means of a compression joint to the pipe and provided with the crystalline phosphate coating on surfaces being in contact with the

pipe, wherein the crystalline phosphate coating prevents a tribocorrosion and increases load capacity as compared to compression joints and creates a stable joint between the pipe and the cam;

a bearing ring having an inner diameter larger than the outer pipe diameter and connected by means of a compression joint to the pipe and provided with a crystalline phosphate coating on surfaces being in contact with the pipe, wherein the crystalline phosphate coating prevents a tribocorrosion and increases load capacity as compared to compression joints and creates a stable joint between the pipe and the bearing ring;

an end piece having an inner diameter larger than the inner pipe diameter and connected by means of a compression joint to the pipe and provided with a crystalline phosphate coating on surfaces being in contact with the pipe, wherein the crystalline phosphate coating prevents a tribocorrosion and increases load capacity as compared to compression joints and creates a stable joint between the pipe and the end piece.

10. (new) A built-up camshaft comprising

an elongated part having an outer cylindrical surface;

a cam connected by means of a longitudinal compression joint to the elongated part, wherein the cam is covered with a joint-stable surface coating, and wherein the surface coating prevents a tribocorrosion and increases the load capacity as compared to compression joints;

a bearing ring connected by means of a longitudinal compression joint to the elongated part, wherein the cam is covered with a joint-stable surface coating, and wherein the surface coating prevents a tribocorrosion and increases the load capacity as compared to compression joints;

an end piece connected by means of a longitudinal compression joint to the elongated part, wherein the cam is covered with a joint-stable surface coating, and wherein the surface coating prevents a tribocorrosion and increases the load capacity as compared to compression joints.

11. (new) The camshaft according to claim 10, wherein the coating (2, 5) is a metal coating or a cement coating.

12. (new) The camshaft according to claim 10, wherein

the pipe or the solid rod and/or the cams, the end pieces, the bearing rings, and the other parts are made out of metal, ceramics, plastics or other materials, by cutting or non-cutting, by milling or forging in massive or profiled form.

13. (new) The camshaft according to claim 1, wherein
the outer jacket face of the pipe or of the solid rod has a drawn quality or is completely or partially mechanically machined.

16. (new) The camshaft according to claim 10, wherein the elongated part having an outer cylindrical surface is a pipe.

17. (new) The camshaft according to claim 10, wherein the elongated part having an outer cylindrical surface is a solid rod.

10. (new) A built-up camshaft comprising
a pipe or a solid rod,

cams,

bearing rings,

end pieces, and

other parts, wherein the cams (3), the end pieces (6), the bearing rings, and the other parts are connected by means of longitudinal compression joints to the pipe or to the solid rod, wherein the parts to be connected are provided with a suitable surface coating, and wherein the surface coating prevents a tribocorrosion and increases the load capacity as compared to conventional compression joints.

REMARKS

Claims 1 through 8 continue to be in the case. New claims 9 through 15 are being introduced.

New claim 9 is based on claim 6.

New claim 10 is based on claims 1 and 2 as originally submitted in the parent application.

New claim 11 is based on claim 3 as originally submitted in the parent application.

New claim 12 is based on claim 4 as originally submitted in the parent application.

New claim 13 is based on claim 5 as originally submitted in the parent application.

New claim 14 is based on claim 1 as originally submitted in the parent application.

New claim 15 is based on claim 1 as originally submitted in the parent application.

4. The listing of references in the specification (e.g., page 5) is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(l) states, "*the list may not be incorporated into the specification but must be submitted in a separate paper.*" Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

The application lists on page 3, line 19 and 20 the East German printed patent document 015 2972.

This reference was also recited in the Information Disclosure Submission filed July 3, 2000 on page 2, lines 17 through 19.

The application lists on page 5, line 13 the German printed patent. document 196 40 872.5. The undersigned has reminded the applicants to promptly resolve this issue.

17. Claims 6 and 7, as best understood, stand rejected under 35 U. S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over East German Patent No. 0152 972 (Pat.'972) described on page 3 et seq. of applicant's specification.

Applicants observe that the reference Pursche et al. (Pat.'972) is entiteled: Shaft-hub connections, in particular pressure connection with coated fitting surfaces.

There is no mentioning of any cams, bearing rings, or end pieces in the reference Pursche et al.

Applicants submit the following additional considerations:

Claim 6 requires a presence of cams, bearing rings and of end pieces, which are not part of the East German Patent No. 0152 972 (Pat.'972).

Claim 7 again requires a presence of cams, bearing rings and of end pieces, which are not part of the East German Patent No. 0152 972 (Pat.'972).

As there is no suggestion of cams, bearing pieces or end pieces in the reference, applicants submit that these claims clearly define over the reference.

The Office Action refers to 35 USC 103.

Pat.'972 according to the Office Action teaches the invention substantially as claimed. However, Pat.'972 does not explicitly teach the dimensions of the cams, bearings, end pieces and pipe, etc.

Applicants respectfully traverse. It is an absolute understatement that "*However, Pat.'972 does not explicitly teach the dimensions of the cams, bearings, end pieces and pipe, etc.*", *when in fact Pat.'972 does not teach at all anything about cams, bearings, end pieces and pipe, etc.*".

Withdrawal of the rejection is respectfully requested.

It is common knowledge in the art according to the Office Action to change the dimensions of the cams, bearings, end pieces and pipe, etc. of

Pat.'972 such that the cams and bearing rings of Pa.'972 have an inner diameter smaller than the outer pipe diameter and end pieces of Pat.'972 have an outer diameter bigger than the inner pipe diameter in order to increase the friction resistance among the cams, bearings, end pieces and pipe to form compression joints. See stare devises about the change in size/proportion cited in M.P.E.P. 2144.04.

Applicants urge that in a situation where there are no "*cams, bearings, end pieces and pipe, etc.*" at all, there is no common knowledge to change such absence.

The Office Action concludes:

It would have been obvious to one having ordinary skill in the art at the time the invention was made to change the dimensions to change the dimensions of the cams, bearings, end pieces and pipe, etc. of Pat.'972 such that the cams and bearing rings of Pa.'972 have an inner diameter smaller than the outer pipe diameter and end pieces of Pat.'972 have an outer diameter bigger than the inner pipe diameter in order to increase the

friction resistance among the cams, bearings, end pieces and pipe to form compression joints as suggested by common knowledge in the art.

Applicants respectfully submit that where there are no cams, bearings, end pieces and pipe, etc. taught in Pat.'972 there is nothing obvious to change dimensions of items not present in Pat.'972.

19. Claims 1-7, as best understood, stand rejected under 35 U.S.C. 102(a) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Seim et al. (Publication "*Erhohung der Sicherheit gehauter...*" cited in EPO Search Report in the parent application).

The Office Action refers to 35 USC 102(a) as follows:

Regarding claim 1, Seim teaches a built-up camshaft comprising a pipe coated by a joint coating on outer and inner cylindrical surfaces (Ibid., Table on page 289 and Fig. 12 on page 290) and having outer and inner pipe diameters; and having cam places, bearing ring places and pipe end places (e.g., Fig. 1, page 284 and Fig. 5 page 286); cams formed as rings with outer and inner cylindrical flanges (Fig. 12) and provided with the

joint coating on an inner cylindrical surface of the inner flange and having a cam opening diameter.

Applicants respectfully disagree. The Seim et al. reference fails to teach the bearing rings and end pieces clearly required according to claim 1.

The Office Action continues that the cam opening diameter inherently is slightly smaller than the outer pipe diameter and the inner ring diameter is inherently slightly smaller than the outer pipe diameter (Fig. 6, page 287 in order to be slipped and compressed to joint them together.

Applicants respectfully disagree. The Seim et al. reference does not teach a built up camshaft, but only a placement of cams onto a tube. Claim 1 in contrast requires the additional presence of bearing rings (line 10) and end pieces (line 12), which are clearly not part of the Seim et al. reference.

Where the reference Seim et al. fails to teach bearing rings and end pieces required according to claim 1, this is not cured by considerations relating to diameter questions.

Regarding claims 6 and 7, Seim teaches according to the Office Action a built-up camshaft comprising a pipe coated with a crystalline phosphate coating or a cement on an outer cylindrical surface and having outer and inner pipe diameters; cams and bearing rings (Fig. 9 and Table on page 289, and Fig. 12) having an inner diameter and end pieces having an outer diameter connected by means of compression joints.

Applicants respectfully disagree. No built-up camshaft is taught by Seim et al. No bearing rings are taught in Seim et al.

The Office Action continues that the cams and bearing rings of Seim inherently have an inner diameter smaller than the outer pipe diameter and end pieces of Seim inherently have an outer diameter bigger than the inner pipe diameter in order to be slipped and compressed to joint them together.

Again, applicants urge that Semi et al. do not teach bearing rings.

The Office Action refers to 35 USC 103(a) as follows:

Regarding claims 1-7, Seim teaches the invention substantially as claimed. See the rejection under 35 USC 102(a) above. However, Seim

does not explicitly teach the dimensions of the cams, bearings, end pieces and pipe, etc. as claimed

Applicants disagree. Seim et al. do not teach any bearings and end pieces whatsoever in clear contrast to the allegation of the Office Action.

It is common knowledge in the art according to the Office Action to change the dimensions of the cams, bearings, end pieces and pipe, etc. of Seim such that, e.g., the cams and bearing rings of Pa.'972 have an inner diameter smaller than the outer pipe diameter and end pieces of Pat.'972 have an outer diameter bigger than the inner pipe diameter, etc. in order to increase the friction resistance among the cams, bearings, end pieces and pipe to form compression joints. See stare devises about the change in size/proportion cited in M.P.E.P. 2144.04.

Applicants urge that where Seim et al and Pursche et al. agree not to furnish any bearing rings and /or end pieces, a person of ordinary skill in the art would follow to what the references agree to and not use hindsight as does the Office Action.

It would have been obvious to one having ordinary skill in the art at the time the invention was made according to the Office Action to change the dimensions to change the dimensions of the cams, bearings, end pieces and pipe, etc. of Seim such that the cams and bearing rings of Seim have an inner diameter smaller than the outer pipe diameter and end pieces of Seim have an outer diameter bigger than the inner pipe diameter, etc. In order to increase the friction resistance among the cams, bearings, end pieces and pipe to form compression joints as suggested by common knowledge in the art.

Applicants respectfully disagree. Still Seim et al. do not teach any bearing rings or any end pieces as clearly required in applicants' claims.

The following considerations are intended to furnish a better perspective of the present invention in view of the references applied in the Office Action.

The recited application Seim et al. presents only that cams can be attached to tubes with the coated press connections of the reference German Democratic Republic patent document 0152972 to Pursche et al.

This reference Pursche et al. does not teach a completely built cam shaft as claimed in the present application. A completely functioning built cam shaft requires besides the cams on the tube in addition the bearing rings for an axial fixing of position of the cam shaft (drive with gear belt or chain). The present application refers to a complete built cam shaft.

The production of a complete built cam shaft including all parts (cams, bearing rings, end pieces), and of not only the cams by press connections with compound stable conversion layers as taught in the reference German Democratic Republic patent document 0152972 to Pursche et al., connected to the tube as disclosed by the present applicants is completely novel and clearly represents a high level of inventiveness relative to the state-of-the-art.

In particular the fitting of the very small bearing rings having a width of about 4 mm is under standard conditions associated with problems as a consequence of the danger of canting, and also the achievement of the required torque transfer capability for the attachment of the end pieces to

the tube by way of press connections is very problematical. According to the German Democratic Republic patent document 0152972 to Pursche et al. the press faces of the shaft cam connections are furnished with an inorganic nonmetallic compound stable conversion layer. This reference Pursche et al. does not mention at all an application for producing built cam shafts. Thus the present application for the first-time furnishes that press connections with inorganic nonmetallic press face coatings are employed for the production of built cam shafts.

It is in particular novel in this context that the cams are hubs with an unequal wall thickness and that sequentially several cams are pressed on, wherein all cams after the first cam, which has the longest press-on path, are again and again pressed-on over the same region, which region had been loaded previously by the pressing-on of the preceding cam, without that disadvantageous occurrences to appear such as seizing and scoring, or of a decrease of the transfer capability.

The tube remains throughout smooth and does not experience any cross-sectional changes at the outer diameter in the region of the cam, which is the case with the constructions of the references Seim et al. and Pursche et al.

The capability and applicability of the present invention for producing built cam shafts has been proven by the construction of samples and by practical testing by the inventors and can be recognized concretely by the figures 1 through 3 and the respective description.

The pressing-on of the cams and of the bearing rings as well as the pressing-in of the end pieces is only possible by the application of special press face coatings. A dry pressing-on or, respectively, pressing-in of the parts without coating, that is steel on steel, would not be possible based on thereby occurring destructive seizing and scoring occurrences. For example a pressing-on or, respectively, pressing-in under employment of suitable lubricants, for example molybdenum disulfide oil paste (MoS2)

would not be applicable, since the transfer capability of the press connections would not be sufficient based on the low friction numbers.

Static rotary tests and dynamic operating loads were performed at the built cam shafts, which were produced as samples by the inventors according to the present application, wherein the experimentally determined transferable loads in this case were disposed by a multiple higher than the loads present or, respectively, required in a practical operation. Thus the functional safety of these built cam shafts has been proven by the inventors.

For a person not immediately concerned with the special field of press connections with inorganic compound stable conversion layers it is possible to quickly suspect contradictions in cases where the conversion layer on the one hand enables the pressing on of the cams without a problem and on the other hand assures also a high capability of transferring forces, that is strength against mutual rotation, to the cams.

However this is not a contradiction, which is to be shown by the following presentation.

Sliding friction (friction of the motion) is present during the pressing on of the cam onto the tube prior to, and after the pressing-on, the sliding friction instantaneously converts into adhesive friction (friction of the rest position). The sliding friction number is always smaller as compared to the adhesive friction number. If now the cams are to be rotated, then therefore not the sliding friction number, but the adhesive friction number (friction number during disengaging) has to be overcome. However in this case it is decisive and very special that the compound stable conversion layers, and in particular phosphate layers, do not have a tendency to adhere, whereby the pressing-on of the cams under sliding friction is possible without problem. Once the cams are pressed-on, then the thin fine crystalline or microcrystalline and very easily deformable conversion layer adapts to the surface profile of the bore hole of the cam such that the so-called microform matching occurs. This microform matching is schematically illustrated in figure 7, where figure 8 is contained in the journal articles G. Pursche, H. Gropp: Belastbarkeit und Lebensdauer von

Pressverbindungen mit phosphatierten Passflaechen, IfL.-Mitteilungen 22 (1983) 6, Pages 225 – 229 and G. Pursche, H. Gropp, and B. Rost, Zur Anwendung beschichteter Pressverbindungen, Agrartechnik Berlin 35 (1985) 4, pages 170-174 (as is figure 7). Detailed explanations of this process were presented in these two journal articles.

A high strength against rotation of the cams on the tube results by this microform matching as a consequence of a very good surface profile adaptation of the conversion layer and as a consequence of the compound stability of the layer relative to the base material. The conversion layer now does not any longer operate as a sliding element as occurred during pressing in, but instead operates as a transfer element in consequence of the generated microform matching.

It is again clearly presented based on this different operating mechanism of the conversion layer under different conditions how these press connections with compound stable conversion layers are at all

applicable for the production of built cam shafts and for the operational safe force transfer capability of the built cam shafts.

In summary it is noted that according to the present application `built cam shafts` it is possible for the first-time to produce a built cam shaft comprising a tube, cams, bearing rings and end pieces by application of longitudinal press connections with inorganic nonmetallic compound stable conversion layers and not only to produce parts of such camshaft such as for example a connection between a cam and a tube as mentioned in the reference Pursche et al.

It is furthermore a completely new aspect of the present invention relative to the state-of-the-art that all cams sequentially are pressed over the same fitting face, without an observation of any disadvantages.

In addition it is new relative to the state-of-the-art that the cams are hubs with the nonuniform wall thickness distributed over the circumference.

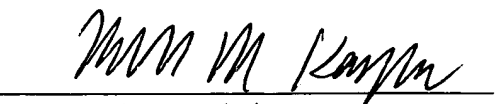
It is urged that even for a person of more than ordinary skill in the art that it is by no means obvious based on the state-of-the-art to obtain this novel production possibility for cam shafts, which is substantially more simple and cost favorable relative to production technology as all other technologies, even those industrially produced, known variations (for example of the widening out under internal high-pressure and the like).

Reconsideration of all outstanding rejections is respectfully requested.

All claims as presently submitted are deemed to be in form for allowance and an early notice of allowance is earnestly solicited.

Respectfully submitted,

Herbert Gropp et al.

By: 

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Reg.No. 28559; Docket No.: RUM212

*%(RUM212A4(August 15, 2001(rep-5101